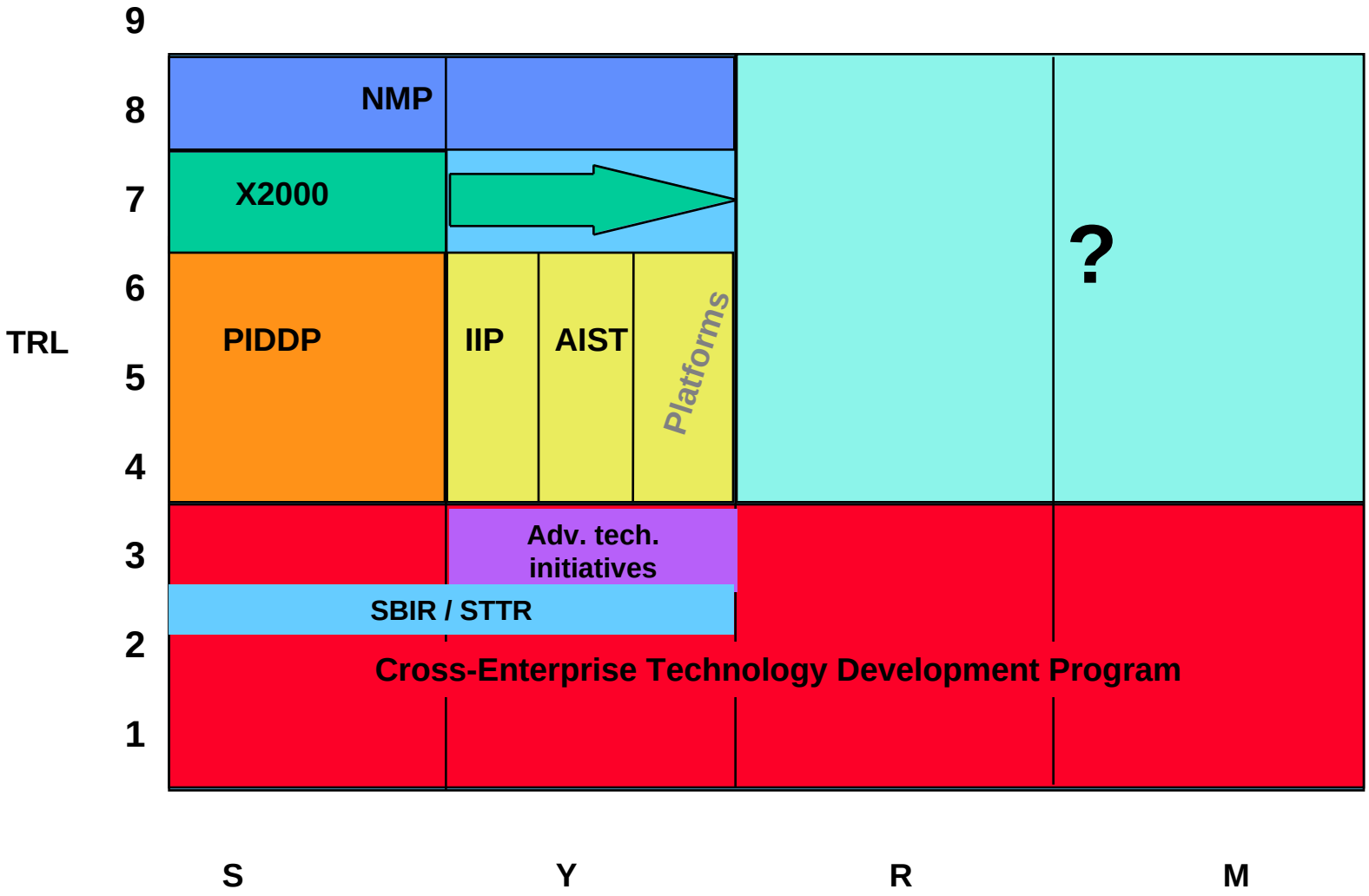
Platforms
Capability Needs Assessment

Technology Strategy Team Quarterly Meeting
Jet Propulsion Laboratory
April 28, 1999

Topics

- Introduce Platform Technology Needs Assessment
- Outline process followed to date
- Present preliminary results

NASA World of Technology development



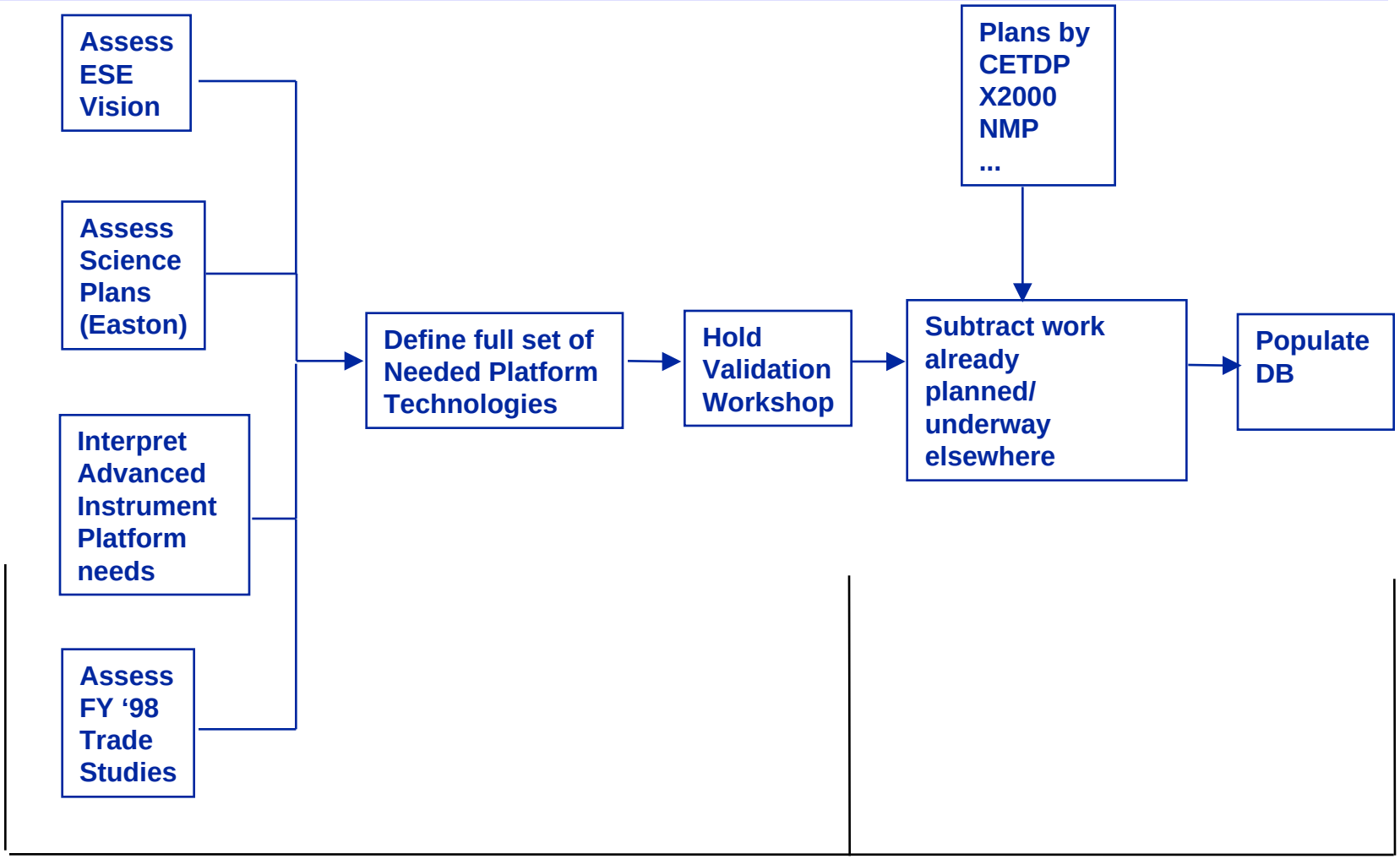
Primary Objectives of ESTO

- Formulate a Comprehensive Code Y technology support program
  - Develop database relating technology needs to future science measurements needed
  - Rank needs and support technology development
  - Coordinate funding with existing programs (e.g., CETDP)
  - Insert Code Y needs into other on-going programs where it makes sense (e.g., X2000)
- Execute highly efficient and focused program of technology development
  - Product-oriented
  - Timely deliveries to support missions
  - Handed off to higher TRL programs where needed for risk reduction

ESTO Technology Investment Program

- ESTO Investment Programs
  - Advanced instruments (Instrument Incubator Program)
  - Advanced platforms Program
  - Advanced Information Science Technology Program
  - Advanced Technology Initiatives
  - Advanced Concepts
- Status
  - IIP: underway with FY 99 funding of about $16M
  - Advanced Platforms: Technology Needs being defined
  - Advanced Information Science Technology: RFI on the street
    - Responses due on May 18
    - NRA anticipated by December
    - Website: http://www.hq.nasa.gov/office/procurement/grants/#mtpe
  - Advanced Technology Initiatives: Funding plans underway at LaRC
  - Advanced Concepts: No current funding plans

Platform: Overall Process



Platform Participation

- Participating Centers
  - LARC
  - GSFC
  - GRC
  - DFRC
  - ARC
  - JPL
- Teams locally directed
- Communication since kickoff meeting via telecons
- Products developed and delivered via ftp

Parsing of problem

	Responsible Center	Contributing Center / Item
S/C	All	GRC, GSFC, JPL, LARC
Airplane	DFRC	
UAV	DFRC	
Balloon	JPL	Wallops
Buoy		
Penetrator	JPL	
Moon	JPL	

Data Sources

- NMP IPDTs
- EASTON Measurement Set
- CETDP
  - NASA Technology Inventory
  - http://ntidb1.gsfc.nasa.gov/EarthScience/SScience/MainTree.cfm
- X2000
  - No formal requirements documentation
  - http://dsst.jpl.nasa.gov/index.html
- ESE “Vision”
  - http://ntidb1.gsfc.nasa.gov/EarthScience/TSTFrame.html
- IIP Abstracts
- Trade Study reports (FY ‘98 studies)

ESTO Instrument Capability Needs DB

Instrument CNA used as a model

NASA Earth Science

Saturday, February 13, 1999

1.Enterprise-EarthScience ::
2.Science Theme-ATMOSPHERE PHYSICS ::
20.Science Need-Aerosol Properties, atmospheric aerosol profile and optical parameters; -global coverage; -spatial res. 100-1000 km; -vertical res. 1 km; - revisit time 1-30 days; - accuracy 10% of optical depth in 1 km layers
122.Measurement Approach-Profile of multiwavelength laser backscatter from atmosphere revealing absorption due to stratospheric and tropospheric aerosols Issues: - Is it "backscatter" or "absorption" due to aerosols that is detected?
9.Instrument Options-In-space multifrequency lidar
115.Measurement Approach-Backscatter and absorption of ~ 750 nm solar radiation by atmosphere revealing scattering and absorption due to aerosols
15.Instrument Options-In-space lidar at O2 -A band
32.Instrument Options-In-space, multiple wavelength lidar with radiometric and polarimetric capability
116.Measurement Approach-Extinction of UV-VIS-NIR solar radiation at multiple wavelengths due to aerosols

Structure of Problem

Objective: Achieve common understanding of how all platforms relate

- **Classification of Sensors**
  - **Remote: Measure a quantity at a distant location**
  - **In-situ: Measure a quantity at the sensor location**
- **Application areas for both**

	Above ground	On/ in ground	On / in Water
Remote	X	X	X
In-situ	X	X	X

- **Implications for Platforms**
  - **Must be able to support all the instrument applications**
  - **Must think broadly of platform types**

Platform Types and Their Application

Results

Remote

	Water	Land	Atmosphere
S/C	X	X	X
Airplane	X	X	X
UAV	X	X	X
Balloon	X	X	X
Buoy	X	X	X
Penetrator			X

In-situ

	Water	Land	Atmosphere
S/C			X
Airplane			X
UAV			X
Balloon			X
Buoy	X		X
Penetrator		X	X

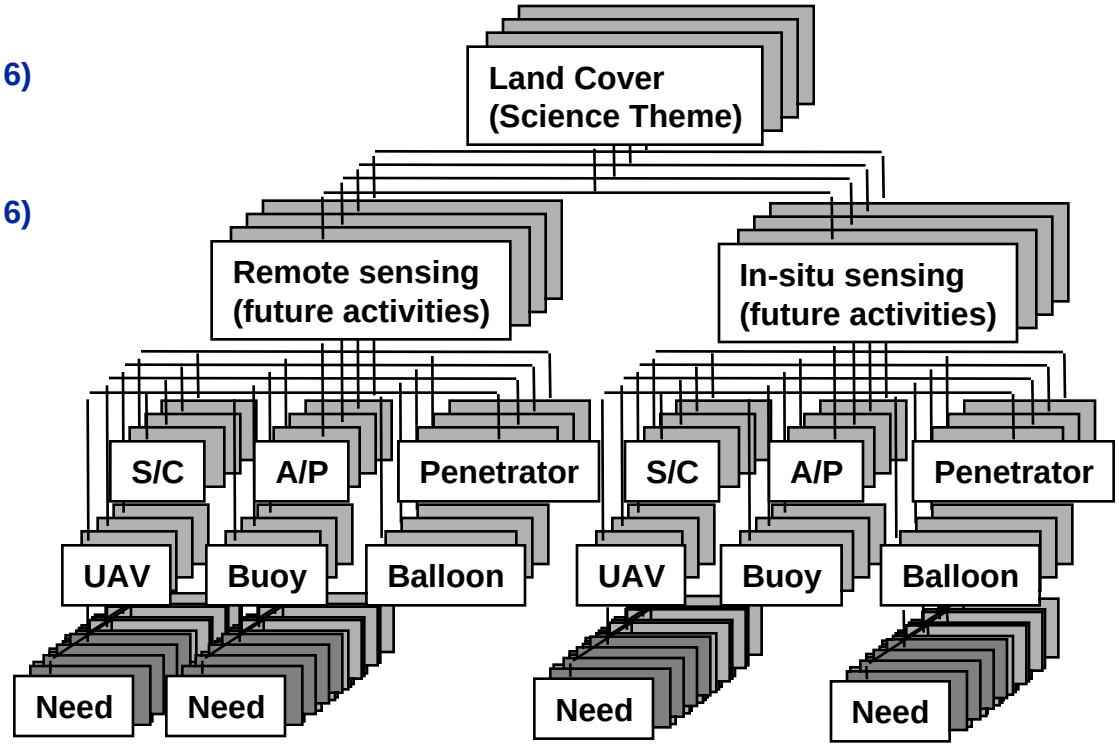
Requirements Structure

Structure Outline

Science Theme (One of the Easton 7)

- Remote
  - Platform (One of the previous 6)
    - Needs foreseen
- In-situ
  - Platform (One of the previous 6)
    - Needs foreseen

Example



Requirements Structure: further detail

- Lower layers of breakout
  - S/C
    - Power
    - Propulsion
    - Telecomm
    - ACS
    - C&DH
    - Structure
    - Operations
  - Buoys
    - Power supplies
    - Packaging
    - Telecomm
    - GPS
    - Facility instruments
  - Penetrators
    - Shock tolerant systems
    - Telecomm
    - Packaging
  - Airplanes / UAVs
    - GPS for experiments
    - Ground Imagers
    - Instrument mounting systems
    - Facility instruments
      - pressure
      - temperature
      - humidity
      - etc
  - Balloons
    - GPS for experiments
    - Ultra-low power systems
    - Long-life systems
    - Autonomous maneuvering

Typical "Record"

Science Theme	Mission Identifier	Mission Scenario	Measurements Needed	Platform Implications	Platform Challenge
Atmospheric Climate Physics	EX-1	Remote sensing of ... with ... sensors using multiple forms of platforms	Spatial and temporal coregistration or knowledge of relative position and timing for coordinated measurements	GPS receivers carried on relevant platforms	Small, low-cost, low operations overhead GPS receivers

From Easton Mission set

This is what we are trying to achieve

This is our "added value," namely, adding insight about the implications of the approach

This is what is needed in new technology

Metrics of data collected

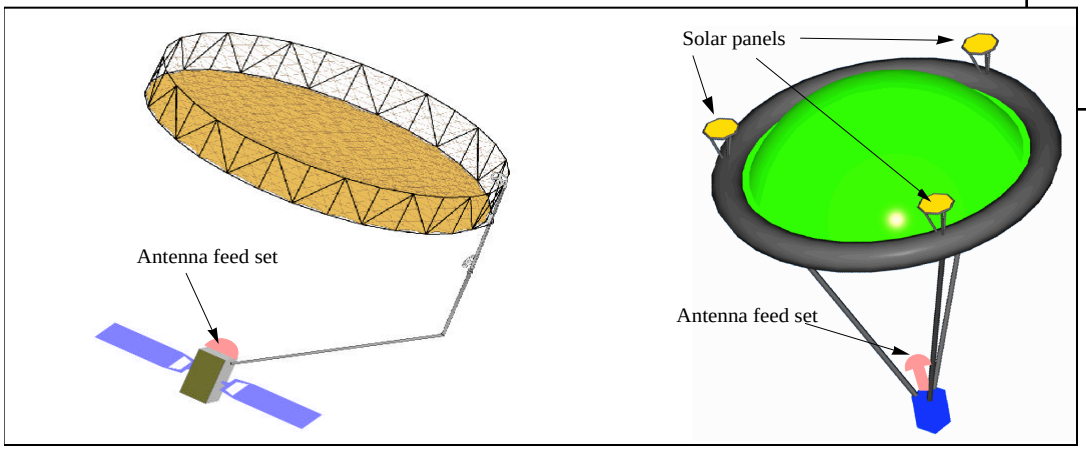
- **Conventional s/c requirements driven by Easton measurement requirements**
  - **Heavily invested in materials and structures**
  - **Probably significant overlap with existing funding programs**
  - **Work remains to identify exclusivity of Code Y requirements**

- **Unconventional platforms driven by vision**
  - **Primarily catalogued as “Derived requirements”**
  - **Significant input for airborne platforms**
  - **Sensor Webs included under various platforms**
  - **Some overlap (TBD) with AIST program**

Sample inputs global water

	B	C	D
1	**Mission Identifier**	**Mission Scenario**	**Measurement Needs**
2	Geostationary Rainfall Monitoring Radar (GRMR)	35-GHz radar instrumentto measurement precipitation monitoring from a geostationary orbit	Vertical resolution (300 m) ; large angular scan without performance degradation; full-disk scan image (at 6000-km surface diameter) every hour ; on-board data processing capability for the generation of 3-dimensional rainfall imagery once per hour

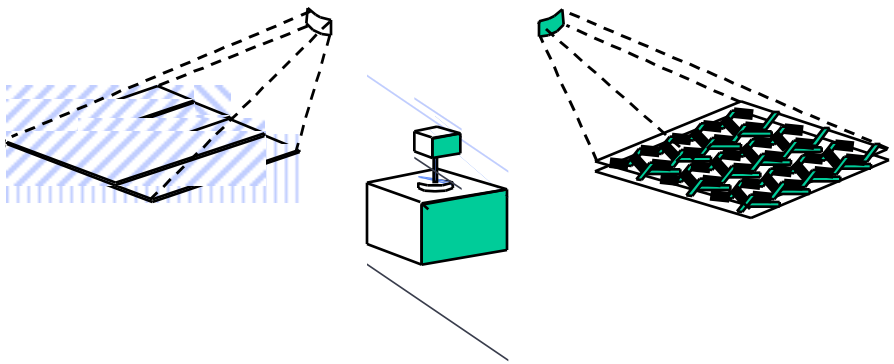
	E	F
1	**Platform Implications**	**Platform Challenges**
	Accommodate large antenna size (see figs. 1 and 2): antenna in stowed position: 5 m x 5 m x 4 m; antenna after deployment: 17m x 17m x 17m	Hold the antenna reflector and the spacecraft stationary as the antenna feeds perform spiral scan maneuvers up to 4.5deg to cover the full disk of the earth. Pointing Requirements: Control: 0.01 deg; Knowledge: 0.005 deg; Antenna pointing station keeping (large antenna must be stared at a desired, fix point on Earth)



Sample inputs for chemistry

	B	C
1	**Mission scenario (interpretation)**	**Measurements needed**
2	High altitude, long-duration science balloons	

	D	E
1	**Platform implications**	**Platform technology challenges**
2	more payload capability	High energy density RFCs can replace heavy secondary batteries; Ni Metal Hydride battery technology currently selected



Sample input for chemistry

	C	D
1	**Mission Scenario**	**Measurement Needs**
2	Remote sensing of the troposphere with UV-Vis and IR imaging spectrometers from GEO	High temporal (one measurement every 15 min.) and spatial measurements of

	E	F
1	**Platform Implications**	**Platform Challenges**
2	Spacecraft pointing stability and knowledge over measurement period	Improved Attitude Control System sensors, actuators, and algorithms

	C	D
1	**Mission Scenario**	**Measurement Needs**
2	Remote sensing of aerosols in the stratosphere and troposphere using solar occultation	High vertical and temporal resolution aerosol profile measurements from multiple

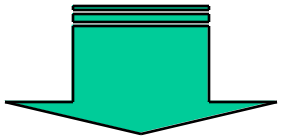
	E	F
1	**Platform Implications**	**Platform Challenges**
2	Minimize operations costs for multiple satellites	Highly autonomous spacecraft control and monitoring systems

Results from 4/27 workshop

- 25+ participants = larger group of technologists aware of/ with understanding of ESE vision
- Significantly improved database of information
- Frustration over lack of definition of future missions
- Stated desire to continue working on defining database
- Recommendations:
  - Increase scientists' involvement in defining mission scenarios
  - Develop a few mission concepts as a basis for evaluating technology needs
  - Develop plausible timeline for advanced missions to help scope and time technology deliveries
  - Keep this group in place for further interactions that build upon workshop results

Conclusions

- We have made a good start at collecting Platform Capability Needs
- Much remains to be done
- Next steps:
  - generate better mission definitions
  - Refine data consistent with above missions
  - Rank needs
  - Scope technology tasks (cost and schedule)



- Form initial plan for platform technology